

Three New Species of Digenean Trematodes Found in Deep-sea Fishes of Japan and Adjacent Waters

Masaaki Machida¹ and Jun Araki²

¹ Department of Zoology, National Science Museum, 3–23–1 Hyakunincho, Shinjuku-ku, Tokyo, 169–0073 Japan

² Meguro Parasitological Museum, 4–1–1 Shimomeguro, Meguro-ku, Tokyo, 153–0064 Japan

Abstract Three new species of digenean trematodes are described from deep-sea fishes of Japan and adjacent waters: *Neolebouria pentacerotis* sp. nov. (Opcoelidae) from the intestine of *Pentaceros japonicus* (Pentacerotidae) of Japan, *Pseudopcoelus akamachi* sp. nov. (Opcoelidae) from the pyloric caeca and upper intestine of *Etelis coruscans* (Lutjanidae) of Japan and Palau, and *Pseudolepidapedon chaunacis* sp. nov. (Acanthocolpidae) from the intestine of *Chaunax tosaensis* (Chaunacidae) of Japan.

Key words: Digenea, Opcoelidae, Acanthocolpidae, new species, deep-sea fish, Japan.

This paper deals with three new species of digenean trematodes found in deep-sea fishes of Japan and adjacent waters. They were fixed in AFA under slight pressure, stained with Heidenhain's hematoxylin and mounted in balsam. The specimens are deposited in the National Science Museum, Tokyo (NSMT). Some Yamaguti's specimens preserved in the Meguro Parasitological Museum, Tokyo (MPM) were examined for comparison with our material. Measurements are given in millimeters unless otherwise stated.

We are grateful to the following fishermen's cooperative associations for giving us facilities during our field work: Irino, Kochi Prefecture; Setouchi, Kagoshima Prefecture; and Nago, Okinawa Prefecture, Japan.

Family Opcoelidae Ozaki, 1925

Genus *Neolebouria* Gibson, 1976

Neolebouria pentacerotis sp. nov.

(Figs. 1–3)

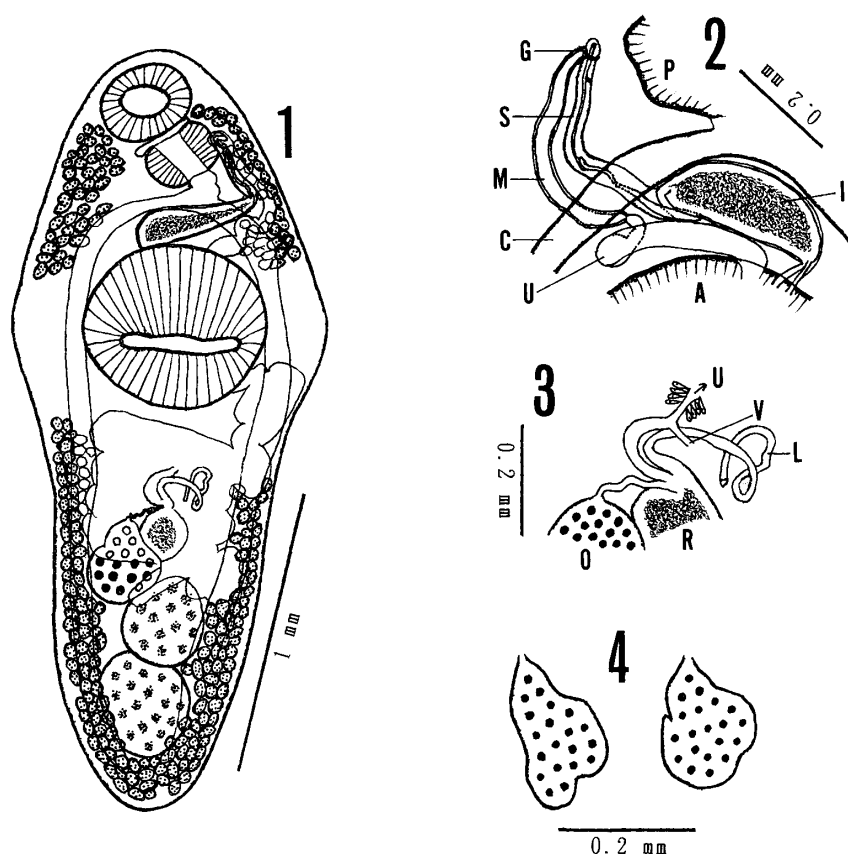
Material. Five specimens from intestine of *Pentaceros japonicus* (Pentacerotidae), Nago, Okinawa Prefecture, Japan, 4–X–1994 (NSMT-PI

4733, holotype and 4 paratypes).

Description. Based on 5 specimens. Body spindle-shaped, rounded anteriorly and tapering posteriorly, 2.6–3.1 long by 0.99–1.20 wide at acetabular level. Tegument smooth. Oral sucker subterminal, 0.18–0.25×0.29–0.34; prepharynx 0.03–0.09 long; pharynx well-developed, 0.18–0.20×0.21–0.26; esophagus short, 0.06–0.10 long, bifurcating midway between suckers; caeca extending near posterior extremity. Acetabulum 0.50–0.58×0.62–0.67. Sucker ratio 1:1.9–2.1. Forebody 34–39% of body length.

Testes smooth, tandem, contiguous, in posterior half of hindbody; anterior testis 0.20–0.34×0.29–0.37 and posterior testis 0.26–0.43×0.28–0.34. Posttesticular space 9–13% of body length. Cirrus sac club-shaped, curved, 0.47–0.59×0.11–0.13, usually touching anterior border of acetabulum. Internal seminal vesicle saccular, occupying almost half of the sac, folded in the distal attenuated portion. Pars prostatica not differentiated. Cirrus slender, convoluted, protrusible. Genital pore sinistral, at pharyngeal level.

Ovary two-lobed, anterior small and posterior large lobes like a Dharma doll, 0.25–0.31×0.27–0.30, slightly dextral, usually in contact with an-



Figs. 1–3. *Neolebouria pentacerotis* sp. nov. —1. Entire worm, ventral view (NSMT-PI 4733, holotype). 2. Terminal genitalia, dorsal view (4733, paratype). 3. Ovarian complex, ventral view (4733, holotype). A, acetabulum; C, caecum; G, genital pore; I, internal seminal vesicle; L, Laurer's canal; M, metraterm; O, ovary; P, pharynx; R, seminal receptacle; S, cirrus sac; U, uterus; V, vitelline reservoir.
Fig. 4. Ovaries of *Plagioporus ira* Yamaguti, 1940 (MPM Coll. No. 22187, holotype & paratype).

terior testis. Mehlis' glands anterosinistral to ovary. Seminal receptacle subspherical, $0.09\text{--}0.20 \times 0.09\text{--}0.16$, anterosinistral to partially overlapping ovary, near median. Laurer's canal sinuous, forming a loop in the middle, extending from anterior to seminal receptacle to open dorsally immediately anterosinistral to seminal receptacle. Uterus between acetabulum and mid-level of anterior testis. Metraterm thin-walled, $0.38\text{--}0.46$ long, $70\text{--}81\%$ as long as cirrus sac, usually exterior to cirrus sac. Vitellaria consisting of relatively large follicles, extending from pre- or postpharyngeal level to posterior extremity, confluent in posttesticular space and occasionally in forebody, with gaps lateral to acetabulum. Eggs $27\text{--}33 \times 15\text{--}20\ \mu\text{m}$. Excretory vesicle I-shaped, extending to ovarian zone; pore terminal.

Remarks. Aken'Ova and Cribb (2001) divid-

ed the species of the genus *Neolebouria* into four groups based on the shape of the testes, their arrangement and on the posterior extent of the cirrus sac. The present new species belongs to their group C with entire, tandem to oblique testes and with the cirrus sac not extending into the hindbody. Aken'Ova and Cribb (2001) contained nine species including their two new species in the group C. These species possess three- or four- occasionally five-lobed ovary except *N. ira* (formerly *Plagioporus ira* Yamaguti, 1940) which has a coarsely indented ovary (Yamaguti, 1940). The present new species differs from them by having two-lobed ovary, anterior small and posterior large lobes; vitellaria distributed with gaps lateral to the acetabulum; and very small eggs 27 to 33 by 15 to 20 μm .

Our examination of the specimens of *Plagio-*

porus ira, holotype and one paratype (MPM Coll. No. 22187), revealed the ovary to possess an anterior conical projection and two posterolateral indistinct swellings (Fig. 4). The ovary, therefore, seems to have uneven surface rather than lobate.

Gibson and Bray (1982) studied the systematics of the genus *Plagioporus* and related genera mainly from Europe, and separated *Macvicaria* from *Neolebouria* based on that the former has an entire ovary whereas the latter has a lobed ovary. Shimazu and Nagasawa (1985) examined their specimens of *Plagioporus apogonichthydis* Yamaguti, 1938 from Japan, and indicated the ovary to vary from rounded to trilobed. They considered *Macvicaria* to be synonymous with *Neolebouria*. The original description of *P. apogonichthydis* stated that the ovary is indented or lobed (Yamaguti, 1938). Our reexamination of Yamaguti's specimens of *P. apogonichthydis*, holotype, one paratype (MPM Coll. No. 22197) and four vouchers (MPM Coll. No. 22198), showed that the only voucher has an ovoid ovary with smooth surface and the others have an irregular-shaped or indistinct lobed ovary, possessing one to five incisions or concavities.

As indicated by Shimazu and Nagasawa (1985), *Macvicaria* seems to be indistinguishable from *Neolebouria* by the shape of the ovary.

Genus *Pseudopecoelus* von Wicklen, 1946

Pseudopecoelus akamachi sp. nov.

(Figs. 5–7)

Material. One specimen from upper intestine of *Etelis coruscans* (Lutjanidae), Koniya, Kagoshima Prefecture, Japan, 8–III–1991 (NSMT-PI 4152, holotype) and 10 specimens from pyloric caeca of *E. coruscans*, Palau, western Caroline Islands, 17–VI–1980 (NSMT-PI 2318, paratypes).

Description. Based on holotype. Body elongated, spatulate, 7.7 long by 1.53 wide at uterine level, rounded anteriorly and tapering posteriorly. Tegument smooth. Cervical glands present. Oral sucker subterminal, 0.43×0.50 ; prepharynx 0.07 long; pharynx subglobular, 0.20×0.24 ; esopha-

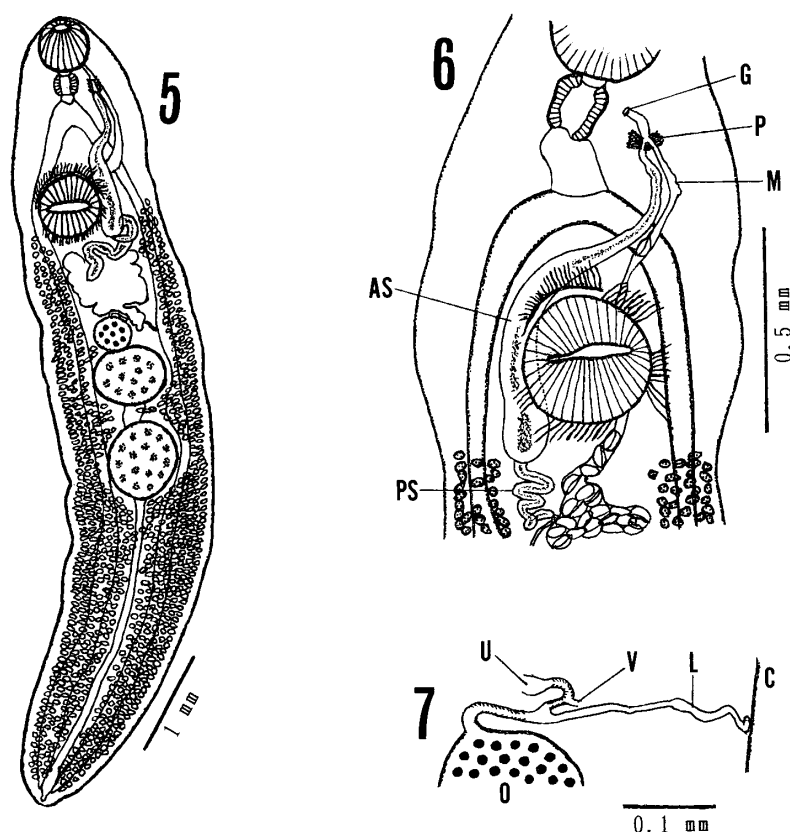
gus 0.10 long, bifurcating much nearer oral sucker than acetabulum; caeca terminating near end of body. Acetabulum 0.62×0.62 , may be protuberant. Sucker ratio 1:1.2. Forebody 23% of body length.

Testes globular, tandem, slightly separated, intercaecal; anterior testis 0.58×0.70 and posterior testis 0.72×0.68 ; posttesticular space 40% of body length. Seminal vesicle divided into two portions; anterior portion slender saccular with swollen proximal end, weakly muscular, extending around left of acetabulum to posterosinistral to acetabulum and posterior portion tubular, sinuous, terminating midway between acetabulum and ovary, nearer acetabulum than ovary. Pars prostatica cylindrical, 0.15×0.04 , surrounded by fine prostatic cells, connects with metraterm near the genital pore, forming short genital atrium 63 μm long. Genital pore sinistral, on posterosinistral edge of oral sucker.

Ovary globular, 0.31×0.39 , slightly dextral, touching anterior testis. Laurer's canal opening in contact with left caecum near postovarian level. Seminal receptacle absent. Uterus intercaecal, between acetabulum and ovary; metraterm weak. Proximal end of uterus full of sperm. Eggs $53\text{--}58 \times 33\text{--}36 \mu\text{m}$. Vitellaria consisting of small follicles, extending from mid- or postacetabular level to posterior end of body, confluent in posttesticular space. Excretory pore terminal; vesicle I-shaped, reaching ovary.

Ten paratypes are young adults with a small number of eggs. They are: Body 2.6–3.7 long by 0.77–1.13 wide at acetabular level. Oral sucker $0.23\text{--}0.30 \times 0.27\text{--}0.42$; prepharynx 0.05–0.15 long; pharynx $0.13\text{--}0.16 \times 0.13\text{--}0.25$; esophagus 0.05–0.15 long, bifurcating midway between suckers. Acetabulum $0.32\text{--}0.48 \times 0.32\text{--}0.54$. Sucker ratio 1:1.1–1.3. Forebody 29–36% of body length.

Testes ovoid with slightly uneven surface, usually wider than long, in contact or separated; anterior testis $0.19\text{--}0.29 \times 0.25\text{--}0.50$ and posterior testis $0.21\text{--}0.32 \times 0.27\text{--}0.53$. Posttesticular space 22–31% of body length. Seminal vesicle divided into anterior saccular and posterior tubular portions; anterior portion usually passing dorsal to



Figs. 5–7. *Pseudopecoelus akamachi* sp. nov.—5. Entire worm, ventral view (NSMT-PI 4152, holotype). 6. Terminal genitalia, ventral view (2318, paratype). 7. Ovarian complex, ventral view (2318, paratype). AS, anterior portion of seminal vesicle; C, caecum; G, genital pore; L, Laurer's canal; M, metraterm; O, ovary; P, prostatic gland; PS, posterior portion of seminal vesicle; U, uterus; V, vitelline reservoir.

acetabulum, but left or right of acetabulum depending on fixation; boundary between two portions lying from midacetabular level to slightly posterior to acetabulum. Genital pore sinistral to pharynx.

Ovary ovoid, $0.10\text{--}0.18 \times 0.15\text{--}0.31$, usually dextral, in contact with or slightly separated from anterior testis. Eggs $48\text{--}55 \times 33\text{--}36\ \mu\text{m}$. Vitellaria extending from post- or occasionally midacetabular level to posterior end of body, confluent in posttesticular space.

Remarks. This species differs from all others in the genus *Pseudopecoelus* by possessing two partitioned seminal vesicle, the anterior saccular and the posterior tubular portions. The posterior extent of the vesicle lies in the anterior hindbody. All other species have a long tubular seminal vesicle extending to the anterior hindbody. The name *akamachi* is from the Japanese local name of the host.

Family Acanthocolpidae Lühe, 1909

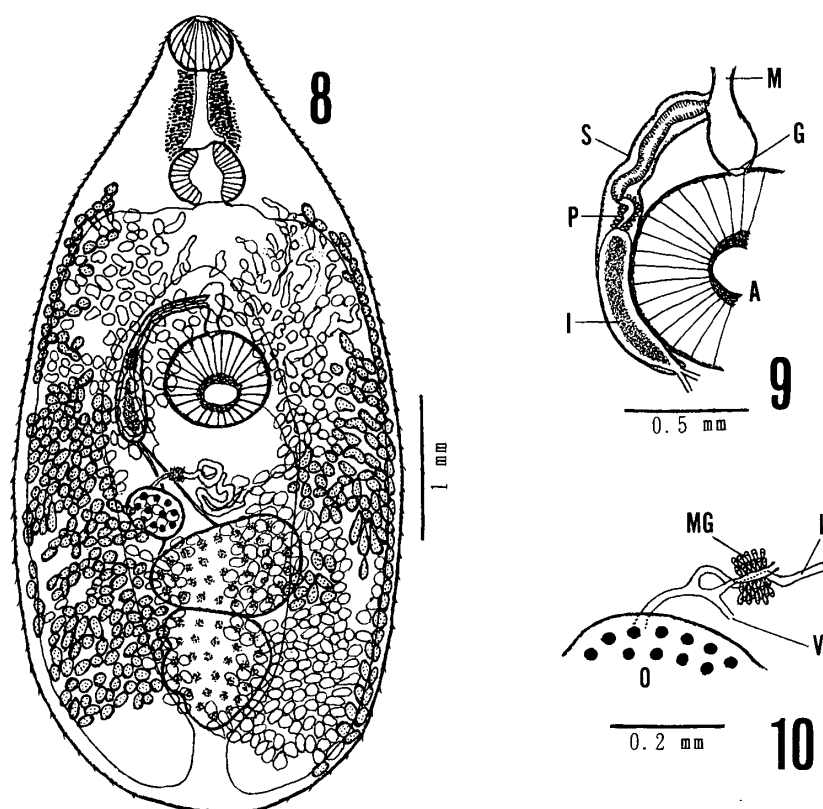
Genus *Pseudolepidapedon* Yamaguti, 1938

Pseudolepidapedon chaunacis sp. nov.

(Figs. 8–10)

Material. Five specimens from intestine of *Chaunax tosaensis* (Chaunacidae), Tosa Bay, Japan, 11–XII–1990 (NSMT-PI 4080, holotype & 4 paratypes).

Description. Based on 5 specimens. Body nearly pyriform, tapering anteriorly and rounded posteriorly, $5.5\text{--}6.6$ long by $2.6\text{--}2.9$ wide. Tegument with spines, sparse posteriorly. Oral sucker terminal, $0.31\text{--}0.38 \times 0.45\text{--}0.50$, mouth facing apically; prepharynx $0.55\text{--}0.65$ long, surrounded by dense glandular cells; pharynx globular, well-developed, almost as large as oral sucker, $0.37\text{--}0.49 \times 0.47\text{--}0.67$; esophagus very short, $0.05\text{--}0.10$ long; caeca voluminous, terminating near posterior extremity. Acetabulum $0.68\text{--}0.91 \times$



Figs. 8–10. *Pseudolepidapedon chaunacis* sp. nov. —8. Entire worm, ventral view (NSMT-PI 4080, holotype). 9. Terminal genitalia, ventral view (4080, paratype). 10. Ovarian complex, ventral view (4080, holotype). A, acetabulum; G, genital pore; I, internal seminal vesicle; L, Laurer's canal; M, metraterm; MG, Mehlis' gland; O, ovary; P, prostatic gland; S, cirrus sac; V, vitelline reservoir.

0.77–0.87, with sphincter around aperture. Sucker ratio 1:1.5–1.7. Forebody 39–46% of body length.

Testes ovoid, tandem, in contact, partially overlapping caeca; anterior testis $0.58\text{--}0.71 \times 0.94\text{--}1.22$ and posterior testis $0.80\text{--}0.98 \times 0.70\text{--}1.39$. Posttesticular space 11–18% of body length. Cirrus sac slender, curved, extending around right of acetabulum to posterodextral to acetabulum; containing saccular seminal vesicle $0.22\text{--}0.62 \times 0.12\text{--}0.25$, short, occasionally S-shaped prostatic vesicle up to 0.28 long, and slender, weakly muscular cirrus. Cirrus sac joining metraterm slightly anterior to acetabulum. Genital atrium tubular to saccular; genital pore median, on anterior border of acetabulum.

Ovary ovoid, $0.32\text{--}0.43 \times 0.44\text{--}0.55$, immediately anterodextral to anterior testis, occasionally overlapping it in part. Oviduct arising from anterior edge of ovary, running transversely to left,

giving off Laurer's canal, connecting with vitelline reservoir, then entering into ootype. Mehlis' glands usually just anterosinistral to ovary. Laurer's canal passing sinuously dorsal to ootype and opening dorsally sinistral to ootype. Seminal receptacle absent. Uterus between preovarian and postbifurcal region. Eggs $78\text{--}84 \times 53\text{--}59\ \mu\text{m}$. Vitelline follicles relatively large, extending from postpharyngeal level to posterior end of body, overlapping caeca dorsally and ventrally posterior to midacetabular level, and confluent in pre- and postacetabular space dorsally. Excretory pore terminal or subterminal; vesicle I-shaped, maybe extending near anterior edge of front testis.

Remarks. According to Bray *et al.* (1996), the genus *Pseudolepidapedon* contains eight species. The present new species is most similar to *P. mordvinovae* Parukhin, 1978 from *Chaunax pictus*, the same host genus as our material, from

the Indian Ocean. However, differences are observed in that *P. mordvinovae* has smaller body 2 to 3.5 long by 1.17 to 1.51 wide, smaller eggs 60 to 67 by 53 μm , and a genital atrium opening in the mid-region of the acetabulum (Parukhin, 1978). Parukhin (1978), however, illustrated the genital pore of *P. mordvinovae* as lying on the anterosinistral rim of the acetabulum.

References

- Aken'Ova, T. O. L. & T. H. Cribb, 2001. Two new species of *Neolebouria* Gibson, 1976 (Digenea: Opecoelidae) from temperate marine fishes of Australia. *Syst. Parasitol.*, **49**: 65–71.
- Bray, R. A., T. H. Cribb & S. C. Barker, 1996. *Cableia pudica* n. sp. (Digenea: Acanthocolpidae) from monacanthid fishes of the southern Great Barrier Reef, Australia. *Parasite*, **3**: 49–54.
- Gibson, D. I., 1976. Monogenea and Digenea from fishes. *Discovery Rep.*, **36**: 179–266.
- Gibson, D. I. & R. A. Bray, 1982. A study and reorganization of *Plagioporus* Stafford, 1904 (Digenea: Opecoelidae) and related genera, with special reference to forms from European Atlantic waters. *J. Nat. Hist.*, **16**: 529–559.
- Parukhin, A. M., 1978. On studies in trematodofauna of the Indian and Atlantic Ocean fishes. *Biol. Morya*, (45): 90–95. (In Russian with English summary.)
- Shimazu, T. & K. Nagasawa, 1985. Trematodes of marine fishes from Moroiso Bay, Misaki, Kanagawa Prefecture, Japan. *J. Nagano-ken Junior Coll.*, (40): 7–15.
- Von Wicklen, J. H., 1946. The trematode genus *Opecoeloides* and related genera, with a description of *Opecoeloides polynemi* n. sp. *J. Parasitol.*, **32**: 156–163.
- Yamaguti, S., 1938. Studies on the helminth fauna of Japan. Part 21. Trematodes of fishes, IV. Publ. by author. 139 pp, 1 pl.
- Yamaguti, S., 1940. Studies on the helminth fauna of Japan. Part 31. Trematodes of fishes, VII. *Jpn. J. Zool.*, **9**: 35–108, pls. I & II.